Final Report

for

Team 26: SAMMC 1

Medical Supplies Warehouse and Picking Optimization

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1.0 EXECUTIVE SUMMARY

The objective is to increase inventory accuracy in the San Antonio Military Medical Center warehouse from their current level of 70%. The medical center's internal inventory accuracy goal is to be at 90%, a 20% increase from their current level. Quantitative and qualitative data are collected during the site visit by interviewing pickers, interviewing management, and personal experience attempting the tasks ourselves. Based on the observations, a task analysis is performed to standardize the required steps and reduce wasted time and motion. From there, appropriate redesigns are developed to address areas for improvement identified in warehouse signage, item placards, and employee training. Recommendations are a redesigned aisle sign that is easier to read from a distance, a new item placard that provides information in a more focused manner, and an updated training program which is more focused and applicable to their day-to-day tasks. These changes are intended to address first and foremost the human error that is easily introduced into the system as currently configured.

2.0 INTRODUCTION & BACKGROUND

San Antonio Military Medical Center (SAMMC) is the largest medical facility in the Department of Defense network, and the only Level 1 Trauma Facility/Burn Center. They assist over 3,000 patients per day, with civilian and military personnel.

The medical logistics warehouse serves over 600 internal customers and 11 external clinics in the SAMMC system. Any supplies delivered from the hospital's major supplier, or shipped in via mail are stored and then distributed through this facility. Clinics around the facility and around the city rely on timely receipt of the required supplies to serve their patients each and every day.

Every time an item is picked incorrectly or in the wrong quantity, a clinic may get too many or too few of an item they requested, or even the completely wrong item. This can prevent them from helping patients in the worst case, and at the very least costs the hospital and warehouse thousands of dollars per week.

The Department of Supply Chain Management at SAMMC desires to develop an optimized system that improves the effectiveness and efficiency of pulling items from the stock in the Supply Chain Management warehouse. Eleven material handlers currently conduct the process of pulling stock from the warehouse shelf as well as putting stock up that is received that day, while balancing competing priorities. A major discrepancy with the pulling of items include: pulling wrong quantities or the wrong item, and items leaving the warehouse without being verified by the customer. The goal is to ensure every piece of material that is pulled from the warehouse stock is properly pulled and in a timely manner.

3.0 PROBLEM IDENTIFICATION

3.1 PROBLEM STATEMENT

Warehouse inventory accuracy currently sits at around 70%, which is below the SAMMC inspection requirement of 90%. This project looks to provide possible solutions to make the job easier for the workers to do their job correctly the first time, bringing the inventory accuracy up. Bringing this number up means that more pickers are doing their jobs efficiently, the warehouse is providing their internal customers the supplies they need when they need them, and the hospital is saving money on lost or misappropriated supplies.

3.2 SCOPE

From a site visit and continued communication between the project sponsor and team, it was identified which aspects of the project would be considered in scope and those that are out of scope. Included in this deliberation were stretch goals that would be tackled if time and resources permit. The tasks that are in scope and out of scope are the following:

In Scope:

- Placard redesign (frequently mispicked items first)
- Create/improve aisle signage
- Standardized picking procedures
- Create simple training deliverables - based on changes made
- Motivation enhancement

Outside Scope:

- Safety Issues
- Space Limitations
- Space Utilization
- Workplace Culture
- Turnover/hiring freeze/personnel
- Worker proficiency of medical terms

3.3 CONSTRAINTS/REQUIREMENTS

After the site visit to San Antonio Military Medical Center, the project sponsor and team agreed that the requirements for this project were to:

- Improve inventory accuracy.
- Construct overview training materials to aid new workers with changes.
- Generate standard operating procedures and procedure enhancements for ideal picking process.

Some constraints that were identified:

- Provide solution that pickers will accept.
- Not make unreasonably difficult changes for warehouse.
- Ensure that management is willing to make changes.
- Make solutions that are accessible for everyone and are available through different mediums.

3.3.1 ECONOMIC FACTORS

When analyzing the problem and requirements stated, the economic factors that needed to be adhered to were not provided. Budget was not actively stated, but implied to be minimal. All suggested solutions have a negligible cost or involve materials already present and available in the warehouse.

3.3.2 HEALTH AND SAFETY

In terms of health and safety constraints with this project, there were not any aspects that would directly harm or possess this possibility within this project. The major warehouse safety improvements fall outside of the scope of the project. Consideration was given in new designs and future project recommendations for human factors and cumulative trauma injury avoidance.

3.3.3 RELIABILITY

When reviewing reliability constraints involved with this project, the solutions provided needed to be able to withstand the daily operations of the pickers. They needed to be durable and long-lasting so that they would not need to be constantly redone. They also need to be easily modifiable in the event that elements of the warehouse change. A small change in the layout or data within the system should not render solutions useless. This may be accomplished through robust solutions or by empowering the sponsors to make changes themselves in the future.

3.3.4 AESTHETICS

In terms of aesthetic constraints involved in a project like this, there were a few that would fall under this category. This project was primarily based on human factors. This required the solutions proposed to be effective in a way that does not detract from the work the pickers and managers do. How the solutions look in terms of how "pretty" they may seem is not relevant, but the way they function in terms of their visual design was extremely important.

3.3.5 ETHICS

When reviewing the ethical constraints related to a project like this, the ones that were evident were simply that the solutions produced must not put workers in a predicament that requires choosing between the lesser of two evils. Stealing is often a large problem in warehouses, and while it was not brought up as an issue in this location, it was noted as something to keep in mind while developing solutions.

3.3.6 POLITICAL AND SOCIAL IMPACT

For this project, there were no direct political or social impacts. This was a result of the problem being associated primarily within the warehouse itself, and thus rarely, if ever, leaving the warehouse. Tangentially, it was made known to the team that a federal hiring freeze was in place for an unknown amount of time. This meant that more personnel was completely off the table as an option in the near future.

3.3.7 MANUFACTURABILITY

Manufacturability constraints involved with this project were simply that the solutions that are provided will need to be able to be made and implemented using the supplies that the warehouse currently utilizes. Nothing needed to be capable of being mass-produced, but be able to be easily implemented across a large warehouse within normal capabilities of the managers.

3.3.8 SUSTAINABILITY

The major constraint for this project's sustainability was that the solutions needed to be able to be reproduced or edited after the completion of this project. The solutions needed to be easily maintained and kept up to date by the workers. They would need the ability to use as well as maintain and update the provided solutions.

3.3.9 COST

With this project, the cost constraints that were identified were simply to use the products and features that are currently in place within the warehouse. It was determined that the solutions would incorporate the use of existing technology and not need to purchase any new products.

3.3.10 PEOPLE

Since this project was primarily based on human factors, there were many constraints associated with people. The solutions that were created needed to be easily accessible to the workers and portrayed in a way that makes their job easier. The solutions created needed to consider the workers' feedback because they are the ones that will be using these solutions on a daily basis. The solutions should be tailored to the immediate needs of the job. One of the biggest constraints in this project was the workers involved in the picking process. There was a large turnover rate between both pickers and managers, with the pickers' average tenure in the warehouse being about 6

months. As a result, the proposed solutions needed to reflect this and be able to be easily accessible and understood by both new and seasoned pickers.

4.0 GOVERNING STANDARDS

In this project setting, there were not any governing standards that required special attention. The team was not required to design solutions that had direct effects on the workers in terms of harmful chemicals, ethical behaviors, or any environmental byproducts. Plenty of standards are applicable to a military warehouse, but most were out of scope for this project.

5.0 METHODOLOGY/APPROACH

5.1 APPROACH TO PROBLEM

In order to understand the methodology that would be used, a clear understanding of the areas that needed improving was required. These areas were determined from observing the pickers during the site visit as well as the conversations with the pickers and managers. The methodology determined for this project was based on the various areas identified as potential areas of improvement. Each area of improvement followed its own methodology to determine a possible solution.

5.2 SITE VISIT/SHADOWING

During a site visit from February 27-28, the team was able to spend the first day learning about the processes that are involved in the warehouse and getting an overview from the manager in charge. The second day consisted of the team shadowing various pickers and asking them questions about their perspectives of the job. Observation analysis and picker interviews allowed for a more defined data collection.

5.3 COLLECT ARTIFACTS

During this site visit, the team wanted to be sure to take pictures and videos of the warehouse and the processes that are involved. This was done so there would be documentation of important aspects as well as having a basis for the final video that would be created.

5.4 TASK ANALYSIS

In order to ensure that everyone involved was on the same page in terms of what occurs in the warehouse, a task analysis of the picking process was constructed. This, along with an observation study of the pickers' daily tasks, helped construct the ideal process that a picker should follow without adding any non-value added steps. This task analysis was then used as a basis in the training program that was created.

5.5 PLACARD DESIGNS

A survey was created to assist in determining the best placard design based on the initial design ideas. The survey was distributed to non-pickers in order to simulate what a new worker would think when viewing each design. The survey consisted of the four placard designs that were created, including the current design being used, and asked a couple of questions related to each design to see if the designs display the information in a clear manner. In addition, this could track how long it took a respondent to select the correct piece of information from given versions of the

placard. This provided another objective data set upon which to base design changes. Based on the results of the survey, the design chosen was that which was deemed the most efficient in displaying the information based on the time it took the survey participants to find each section. From this design, a model of it using Excel VBA was created to automate the conversion.

The team's preference was to ensure the Defense Medical Logistics Standard Support (DMLSS) software currently employed at SAMMC was capable of implementing the changes the team has proposed. After discussions with the team's sponsor, it was decided that an Excel macro would be the best way to convert the original placards to the proposed design with the use of a button.

5.6 AISLE SIGN IMPROVEMENTS

The font height of the aisle signs in the warehouse was 0.5 inches and not easily identifiable. The team sought advice from Dr. Farzan Sasangohar, a Human Factors and Ergonomics professor and researcher in the Industrial and Systems Engineering department at Texas A&M University, regarding methodologies used for calculating the proper font height. Three separate calculations were done by the team to determine the minimum font height for the final design. Prior to the calculations two constants were chosen due to the employee population and the layout of the warehouse: the average standing eye height was determined to be 67.1 inches and the viewing distance was determined to be 20 feet from aisle sign.

5.7 TRAINING PROGRAM

Each version of the training was designed with slightly different intent, as described above. In the case of the online training, the goal was to create a training program that provided an easy and quick way for pickers to understand the process in its entirety. Comprehension, elimination of confusion, and ease of use were the key metrics. Thus, the process started with the knowledge gained from the site visit, and from the Power Point slide deck that was a provided training resource, and organized all of the relevant information. The first outline was created based on the previous training deck, and then additional information and clarification added based on where common errors were occurring, or removed where unnecessary information was being communicated. This outline would be the basis for all forms of the updated training materials.

For the online version, this information was intended to be as interactive as possible, so as to keep viewers interested, force them to pay attention to the material, and increase the difficulty of answers being passed around for quick training completion. The team researched many options for creating this training, but many had limitations such as the type of question available, ability to grade the results, and cost. Thus, the training moved towards an unlikely candidate in Qualtrics. Qualtrics is generally marketed and used a data collection and survey tool, a capability the team took advantage of as well. However, its customizability made it a great candidate for training, once its powerful feature set was recognized. Qualtrics allowed testing and building of a design that incorporated pictures, questions of varying types, and easy online access, fulfilling all requirements for a training program to upgrade their current system.

5.8 SPAGHETTI DIAGRAMS

As the focus of the team centered around the increase in accuracy, it became apparent that it was imperative to better understand the picking process. During the site visit the team set out to record this process by shadowing many of the pickers. As a picker was shadowed two team members would take notes based on movements between locations within the warehouse while identifying the reasons for those specific movements. All notes were carefully collected and documented during the site visit and compared between team members upon returning.

5.9 HUDDLE BOARDS

Currently pickers do not have a visual outlet to view their cumulative performance or give suggestions and feedback for process improvements based on their experience. As a team of pickers, having an understanding of current performance compared to goals and requirements set by the hospital and superiors is necessary for growth and aids in motivation. With this in mind, the team decided through analysis what information would be of benefit for the pickers and managers to review frequently while also providing an outlet for picker recognition and warehouse goal setting. From there the "huddle boards" were created

6.0 PROJECT SCHEDULE

Conference Calls
- February 14: With CPT. Morris and TSgt. Awanda
- April 12: With CPT. Morris and TSgt. Awanda

Site Visits
- February 26-28
- April 17
- May 5 (Closeout Meeting)

Team Meetings
- Every Tuesday from February - May
- February 23: Meeting with Dr. Sasangohar
- March 21: Meeting with Dr. Sasangohar
- March 27: Team Meeting
- April 4: Meeting with Dr. Sasangohar
- April 24: Meeting with Dr. Sasangohar

Deadlines Met
- February 16: Code of Cooperation
- March 9: Project Charter
- March 27: Conclude Solutions Brainstorming
- March 27: Present Initial Placard Designs
- April 11: Distribute Survey
- April 17: Video Storyboard
- April 17: Begin Working on Final Project Deliverables
- April 21: Preliminary Poster Design
- April 24: Final Report Draft
- April 27: Final Poster
- May 1: Team Video
- May 9: Final Report
- May 17: Warehouse Stand-Down Day

Data Provided
- February 14: Work Production/Cost of Missing Items Provided
- March 21: Inventory Operating Balance/Item List Provided

Presentations

April 28: Engineering Project Showcase
May 3: ISEN Project Presentations
May 5: SAMMC Closeout Meeting

7.0 ANALYSIS OUTCOME AND FINDINGS

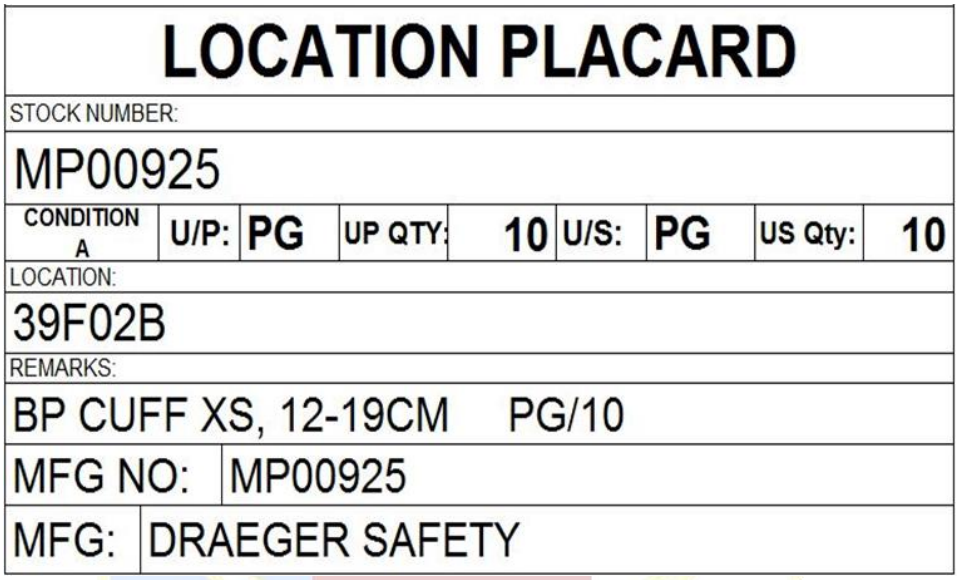
7.1 TASK ANALYSIS

When the task analysis of the picking procedure was mapped out, the team observed that this process does not happen with regularity. There were many times that pickers went from one place to another multiple times because they forgot to obtain a material they need or because they were searching for a particular item and could not find it. This task analysis was done in the hopes of saving the pickers time during their pick as well as reduce the distance that each picker has to travel on a daily basis. This would not make a big difference in the course of a day, but if followed for an extended period of time, a difference in efficiency and time taken to complete picks could be noticed.

7.2 PLACARD DESIGNS

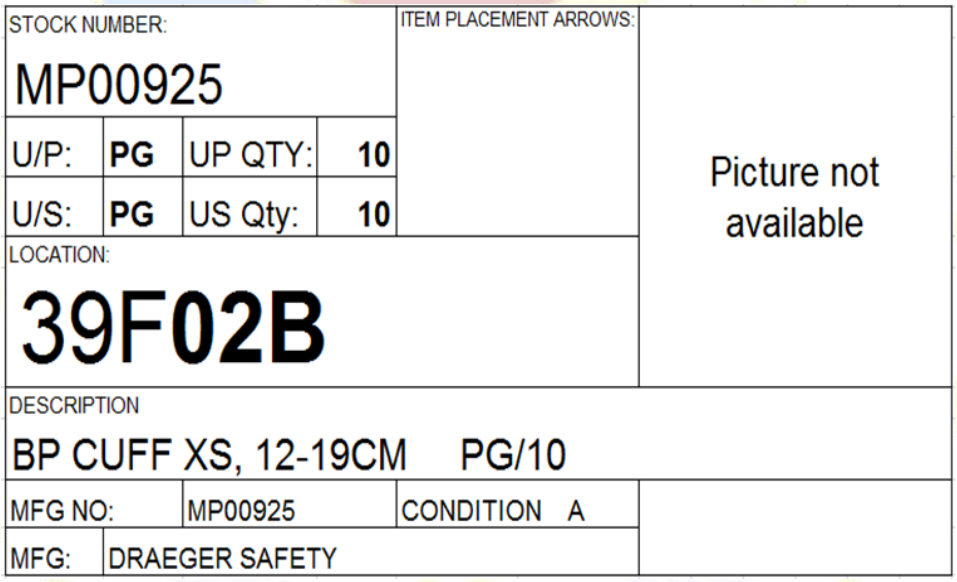
After discussing the original placard design with the warehouse managers and the team, the problem areas were quickly identified. One of the main concerns brought up by the managers was that when they first started working in the warehouse pickers did not know what the important information was because all of the boxes and fonts were uniform. They felt that many of the pickers would take some time trying to figure out where the required information was a result of the uniformity. This was one area of improvement that the managers felt would be beneficial for both new and experienced workers. Another finding was that many picking errors were a result of only picking half of an item, such as only the canister when it should have been a canister and lid. The managers felt that putting a picture into the design would alleviate these problems since the pickers would be able to see the exact item that needs to be picked as well as how it is picked in terms of quantity. To accommodate the issue of uniformity on the placards, it was determined that the best way to effectively show the information that is important was to have the most important aspect, the item location, in the largest font with the other areas decreasing in font size according to importance. In the end, the item location, the stock number, the item description, and the unit of purchase and unit of sale information were the areas that had the largest fonts. When the preliminary design was shown to managers, they felt that the design would help the pickers identify the important information on the placard to allow for a reduction in mispicked items.

In order to simulate what new workers would think the first time they were to see the placards, the surveys that were created were sent to a mix of engineering students and non-engineering students. The results that were analyzed from the survey included the percentage of each question that was chosen correct and most importantly, the time it took for the taker to answer the question. Out of the four designs, the original placard (In Figure 1, below) design had the longest time to answer. The two designs that had the quickest response time were also the ones chosen as representing the information in the most efficient manner. The students surveyed also included comments on what they felt were the best and worst aspects of each design. These comments along with the comments made by the warehouse managers allowed for a design to be created that took all of these factors into account (as seen in Figure 2).



LOCATION PLACARD							
STOCK NUMBER:							
MP00925							
CONDITION A	U/P:	PG	UP QTY:	10	U/S:	PG	US Qty: 10
LOCATION:							
39F02B							
REMARKS:							
BP CUFF XS, 12-19CM PG/10							
MFG NO:	MP00925						
MFG:	DRAEGER SAFETY						

Figure 1: Original Placard Design



STOCK NUMBER:				ITEM PLACEMENT ARROWS:	
MP00925					
U/P:	PG	UP QTY:	10		Picture not available
U/S:	PG	US Qty:	10		
LOCATION:					
39F02B					
DESCRIPTION					
BP CUFF XS, 12-19CM PG/10					
MFG NO:	MP00925	CONDITION A			
MFG:	DRAEGER SAFETY				

Figure 2: Proposed Placard Redesign

Once the final design was created, an Excel VBA code was created to convert an exported version of their original placard to the new design. The code reads the cells from the original design and changes the box sizes, font size, and placement of each aspect. The addition of the picture in the top right corner was an aspect that was asked of by the managers in the hope that that it would make the identification of the required item easier. This portion was done by asking the user if there is a picture available for the item being converted. If there is no picture, the box will say "Picture not Available". If there is a picture available, the user will be taken to the file explorer so they can choose the exact file they want to import. This gives the user complete control of where they want to go as well as choose the specific picture they want with no complications. Once the picture is chosen, the picture will be placed in the top right corner of the placard.

7.3 AISLE SIGN IMPROVEMENTS

The first formula used was developed by Holick and Carlson, 2002, and takes into account the viewing distance and visual angle in minutes of arc, commonly used in circumstances for angles less than 10 degrees. This calculation resulted in a minimum font height of 0.74 inches for minimal recognition by the viewer.

Next, the team used a formula that is widely known as a "rule of thumb" and most commonly identified by Peters and Adams, 1959. This formula uses constants to take into account the viewing distance, reading conditions, lighting, and message urgency. This calculation resulted in a minimum font height of 0.82 inches.

Lastly, the team recreated the system to measure the calculations. From eye height, standing 20 feet away, one string was used to visually represent the line of sight to the bottom of the text. An additional string was used to represent the line of sight to the top of the text and was placed at an angle of 10 minutes of arc above the first. The distance between the two strings at the point of the text was 0.94 inches and represented the recommended font height.

After taking the results from the three separate calculations into consideration as a minimum for the font height for the aisle signs, it was decided to increase the font height from this minimum to 2.5 inches for the final design solution to compensate for additional factors such as lighting, obstructing objects, and varying employee height and eyesight.

7.4 TRAINING PROGRAM

From the task analysis that was performed, the ideal picking process in the warehouse was observed. From this and the presentations provided by our sponsor, the basis for the training program was presented. When thinking about the best way to go about creating a program that would benefit the pickers the most, both new and seasoned, the team asked Dr. Sasangohar what he thought about the situation. Through these discussions, it was determined that having multiple mediums for the training would be the best course of action. It was observed that the pickers do not particularly retain the knowledge from the current online training because it contains material that does not pertain to them or their job requirements. As a result, the team decided that an online training would be made that consisted of the daily tasks that each picker goes through. With this, the pickers would be able to go through a training that has only the information that they need in order to do their job to the best of their abilities.

Initial concerns about access to training materials to look up "correct" procedures were addressed by considering three versions of the training. The hard copies that would be attached to the workstations are intended to be used as a reference if there is a specific portion that the picker is unsure about and do not have immediate access to a computer. All of the pertinent information from the online program will be in a single hard copy version. The last form would be a reference card that the pickers would be able to carry around with them on the floor. This will allow them to see the standard operating procedure that is in place to make sure that there are no discrepancies, in the hope that more attention will be paid during the pick. The back side of the reference card will have a key of the new placard design to be used if the picker were to have a quick question about what a certain portion means. These training programs would be used as a way to promote a standard operating procedure for the warehouse.

Once the idea for the online training was pursued, thoughts on how the pickers would reference the training if they ever had any questions arose. This was a significant problem because there are only four computers for the 13 pickers on the floor. As a result, a computer to reference the training may

not be readily available. Based on this observation, it was then determined that another form of the training that can be kept on the desk itself would help resolve this problem. A hardcopy of the online training that contained the ideal process and step-by-step process of the important sections was created. The ideal process that was created from the task analysis would be the first page so the pickers would know what the best way to go about the process would be. In the task analysis, three steps, generating and printing the picklist, reading the picklist and placards, and confirming the picklist, required numerous steps for those sections. As a result, following the ideal process page is a step-by-step breakdown of these three steps which are accompanied by pictures and explanations for most of the steps. In order to simplify the process of finding each of these three steps, tabs were placed on the first page of each to enable easy access to the sections. The team's recommendation is to have either four or five copies on the computer desk so the pickers could have easy access to them should they need it.

Since changes to the location placards are being proposed, the team felt that a reference card that can be attached to their other badges that contains a legend of each section of the placard would help any confusion the pickers may have when looking at the items and have a question. The reference card is 2.13" wide and 3.38" tall, the standard size of any identification card, and has the legend of the placard on one side with the other side containing the ideal process flow that is on the first page of the hard copy training that would be located on the desks. **Figures 3** and **4** show the two sides of the reference card at the actual size that they would appear on the badges.

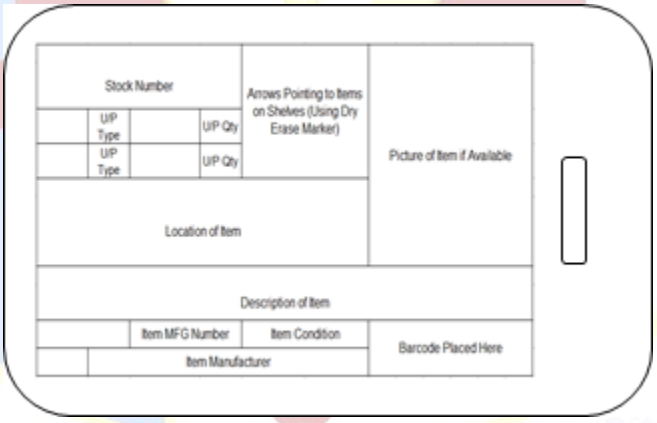


Figure 3: Side 1 of Reference Card

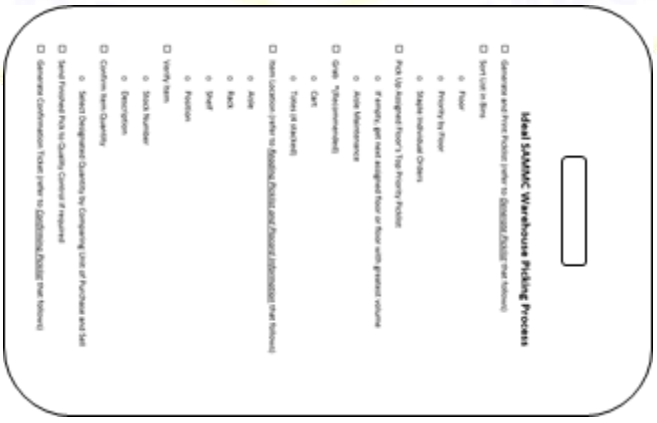


Figure 4: Side 2 of Reference Card

7.5 SPAGHETTI DIAGRAMS

Upon comparing the documented notes of how the pickers flowed throughout the warehouse, it was noted that there was not a standard procedure set in place in regards to the movement made during a pick. This was seen by identifying the differences in picks amongst different pickers. It was noted that there was overlap in the paths taken due to a picker simply forgetting a step. This is not an error to always be connected to the human, as human error can be attributed to an ineffective process or unset operating procedure. In order to identify the areas for improvement the flow of the pickers was mapped. Once this mapped version of the current flow was complete **(Figure 5)** a simplified lean version of the flow was created **(Figure 6)**. Each arrow in the diagram represents one trip along that path in the specified direction. As shown in the current flow most paths are traced twice. This is then improved in the new proposed standard flow procedure.

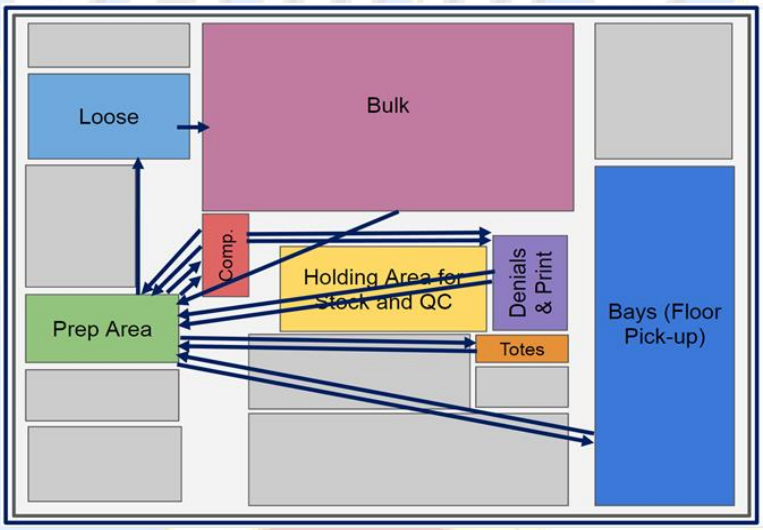


Figure 5: Current Picker Flow

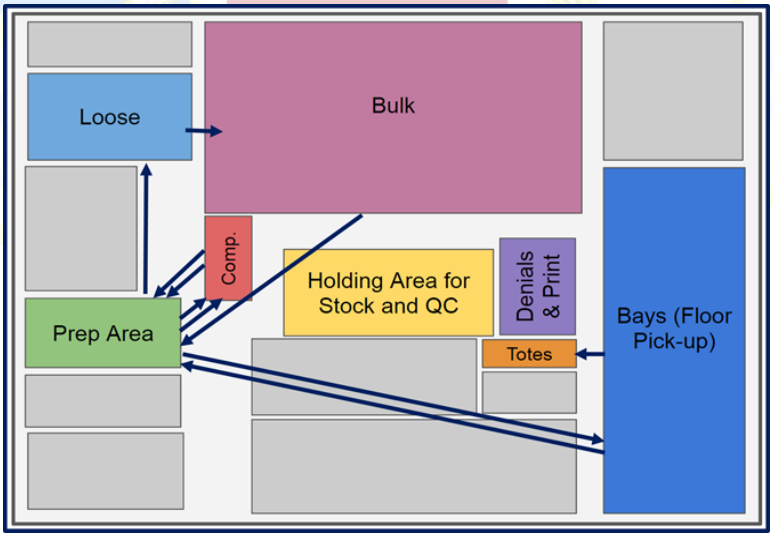


Figure 6: Proposed Lean Picker Flow

7.6 HUDDLE BOARDS

The huddle board **(Figure 7)** was designed as an outlet for communication and growth. The top left area of the board is designed for pickers to be recognized for their hard work as a team and individual motivator. Not only does this section highlight pickers that are performing above standards but also gives other pickers ideas in how they can improve. The middle section is defined as process goals. It is intended to be a continual check of how the operation is moving in terms of their goals that is represented visually for both pickers and management to see. This section also recognizes the individuals or team responsible for executing the goal. The right column labeled performance is geared to create an open dialogue between the pickers and management. Any areas of improvement noticed by pickers or management can be noted here and can be further discussed and developed into a team victory. The table located in the bottom left hand corner of the huddle board was designed to be a visual representation of the current operation allowing both management and the pickers to be on the same page in terms of the level of operation success. This section also has an area to list the pickers assigned to the specific floor. This allows for accountability of each picker but also the pickers as a team. The last section is the notes section that was created as another area of open dialogue between pickers and management. This board is intended to increase communication, performance, and motivation through positive experience.

Team

Team:

Member 1	Member 5
Member 2	Member 6
Member 3	Member 7
Member 4	Member 8

Recognized Members:

Member	Action
Member 1	100% - Accuracy 1 Month
Member 5	Always early

Process Goals

Goals:

Metric	Actual	Target	People
% Accuracy	70%	90%	

Performance

Obstacles:

Possible Solutions:

Successes & Victories:

Notes:

Floor	% QC					# Errors					People
	M	T	W	R	F	M	T	W	R	F	Week Of ____
1											
2											
3											
4											
5											
6											
7											

Figure 7: Huddle Board

8.0 RECOMMENDATIONS

8.1 CONCLUSION

Throughout the course of this project, the team worked on thinking about ways the warehouse would be able to reduce the errors in inventory accuracy by targeting new workers and finding ways to reduce the amount of human error involved in the picking process. By focusing on reducing human error, the team was able to construct ideas on how to make changes to the daily tasks of the pickers to make it easier for them. In terms of the training program proposed, the three-pronged approach allows for different mediums to be used to accommodate the best way for each picker. It

allows them to see the training online, in a hard copy version, and a reference card that they would keep on their badges. With the placards, the picker is able to see the importance on it based on the font size being used. This helps guide the pickers' eyes to the areas that are most important first, following to the next largest size after each one. The aisle signs helps the pickers see which aisle they will be going to from further away rather than being required to be closer to the sign. This was done in the hope of reducing the amount of time a picker takes finding the right aisle and proceeding to find the items in that area. The huddle boards will allow for increased two-way communication between the pickers and management. Rather than having to rely on sending e-mails and making the pickers find time to check one of the four computers, the comments from both management and pickers will be visible on a constant basis. This will help communicate quick problems as well as recognize exceptional pickers.

8.2 CURRENT STATE

Based on the current state of the SAMMC warehouse, there is a lot of room for human error to negatively affect the inventory accuracy. To help alleviate this issue, the team's suggestions are to adjust aspects of the pickers' daily tasks to make the process easier on the pickers and reduce human error. To do this, the team recommends that the warehouse implement:

- A training program across multiple formats so they are readily accessible to all pickers. The formats that are recommended are an online version, a hard copy version located at the computers, and a reference card that the pickers would have on their badges.
- Changes in the aisle signs that include making the font size of the row number and the name of the material handler larger so the pickers can view the information from a further distance.
- Make slight changes to the item location placards by changing the box sizes and adjusting the font within each box depending on the importance of each aspect. By adjusting the font size according to importance, the pickers' eyes will be guided to the most important aspects first to help them know what they should be picking.
- A huddle board design to encourage two-way communication and continuous improvement throughout the warehouse.

These recommendations are being communicated as a possible means of resolving the problem of the warehouse inventory accuracy not meeting management's internal goals.

8.3 FUTURE STATE

The team identified three additional opportunities for improvement within the SAMMC warehouse that were unable to be addressed due to scope constraints. As changes to the QC process in the warehouse continued to be made, the team recommended that a standardized process for determining the level of QC be made based on further statistical analysis. Studies into potential modifications or additions to the current cart system for pickers is also recommended. Lastly, a comprehensive analysis on the workplace culture and environment is proposed to better understand the employee motivation levels as it relates to picking accuracy.

9.0 APPENDIX

9.1 REFERENCES

Affairs, Assistant Secretary for Public. "Task Analysis." Usability.gov. Department of Health and Human Services, 06 Sept. 2013. Web. 09 May 2017.

Womack, James P., and Daniel T. Jones. Lean Thinking: Banish Waste and Create Wealth in Your Corporation. London: Free, 2003. Print.

9.2 SKILLS AND CAPABILITIES USED IN THIS PROJECT

The project with San Antonio Military Medical Center allowed for a variety of both engineering and non-engineering based skills to be used. These skills included:

- Human Factors analysis
- Task analysis skills
- Project management techniques
- Observation studies
- Heuristic evaluation
- System modeling
- Communication skills
- Identifying warehouse problems on a quick time table
- Lean engineering techniques
- Questionnaire /survey construction
- Ability to work with both skilled engineers and non-engineers
- Gained warehouse operation knowledge
- Audio and video production

9.3 PLACARD EXCEL VBA CODE MANUAL

Excel VBA Macro Placard Conversion

1. Export original placard from DMLSS to Excel
2. Click “Enable Content” at top of Placard Conversion Excel Worksheet
3. If export looks like template in “Report 1” tab,
    a. Copy and paste the export in same boxes
    b. If not, put boxes from exported DMLSS placard in corresponding cells in “Report 1” (leave section items in “Report 1” tab, only change values)
4. Go to “Redesign 1 VBA” tab
5. Click the Convert Placard from Report 1 Format” button
6. Select whether there is a picture available for item
    a. If yes, click “Yes” and select file from File Explorer that appears for the item
    b. If no, click “No” and “Picture not available” will appear where picture is located
7. If a new placard is wanting to be made and a placard is present in “Redesign 1 VBA” tab, click “Reset Worksheet to Original Format” to erase contents and start process again

VBA Code Details

- Lines 3-21: Declare all necessary variables
- Line 24: Make “Redesign 1 VBA” active sheet
- Lines 27-36: Adjust row height of necessary cells for new placard design (Rows 3-12)
- Lines 39-50: Adjust column width of necessary cells for new placard design (Columns F-Q)

- Lines 55-56: Make range that will be placard and create border around this new area
- Lines 59-60: Create range for stock number title section and merge into one cell
- Lines 62-65: Insert value from Report 1 (B3) into F3 of new sheet, change font size to 11, and fill cells white
- Lines 68-69: Create range for stock number section and merge into one cell
- Lines 71-73: Insert value from Report 1 (B4) into F4 of new sheet and change font size to 28
- Lines 76-80: Insert Unit of Purchase Type Title value from Report 1 (D5) into F5 of new sheet, change font size to 18, and create border around new cell
- Lines 83-89: Insert Unit of Purchase Type value from Report 1 (G6) into G5 of new sheet, change the font size of 18, create a border around the cell, and bold the font
- Lines 92-96: Insert Unit of Purchase Quantity Title value from Report 1 (H5) into H5 of new sheet, change the font size to 18, and create a border around the cell
- Lines 99-105: Insert Unit of Purchase Quantity value from Report 1 (J5) into I5 of new sheet, change the font size to 18, create a border around the new cell, and bold the cell's font
- Lines 108-112: Insert Unit of Sale Type Title value from Report 1 (K5) into F6 of new sheet, change the font size to 18, and create a border around the new cell
- Lines 115-121: Insert Unit of Sale Type value from Report 1 (L6) into G6 of new sheet, change the font size to 18, create a border around the new cell, and bold the new cell's font
- Lines 124-128: Insert Unit of Sale Quantity Title value from Report 1 (N5) into H6 of new sheet, change the font size to 18, and create a border around the new cell
- Lines 131-137: Insert Unit of Sale Quantity value from Report 1 (P5) into I6 of new sheet, change font size to 18, create border around new cell, and bold the new cell's font
- Lines 140-141: Create range for the Item Arrows and merge the cells into one cell
- Line 143-145: Insert "ITEM PLACEMENT ARROWS" into cell J3 of new sheet and change font size to 10
- Lines 147-150: Align font to center horizontally, top vertically, and create a border around new cell
- Lines 153-156: Create range for the Item Picture, merge into one cell, and create a border around the new cell
- Lines 159-160: Create range for the Location title and merge into one cell
- Lines 162-165: Insert Location title value from Report 1 (B7) into F7 of new sheet, change font size to 11, and fill the cell white
- Lines 168-169: Create range for Location and merge into one cell
- Lines 171-175: Insert Location value from Report 1 (B8) into F8 of new sheet, change the font size to 50, and bold the last 3 characters of the location
- Lines 178-179: Create range for Description Title and merge into one cell
- Lines 181-184: Insert "DESCRIPTION" into F9 of new sheet, change the font size to 11, and fill the cell white
- Lines 187-188: Create range for Description and merge into one cell
- Lines 190-194: Insert Description value from Report 1 (B10) into F10 of new sheet, change the font size 22, and create a border around the new cell
- Lines 197-198: Create range for MFG Number Title and merge the cells into one cell
- Lines 200-204: Insert MFG Number Title value from Report 1 (B11) into F11 of new sheet, change font size to 14, and create a border around new cell
- Lines 207-208: Create range for MFG Number and merge the cells into one cell
- Lines 210-214: Insert MFG Number value from Report 1 (F11) into H11 of new sheet, change the font size to 14, and create a border around the new cell
- Lines 217-218: Create range for Condition and merge into one cell
- Lines 220-224: Insert Condition value from Report 1 (B6) into J11 of new sheet, change the font size 14, and create a border around the new cell

- Lines 227-231: Insert MFG Title value from Report 1 (B12) into F12 of new sheet, change the font size to 14, and create a border around the new cell
- Lines 234-235: Create range for MFG and merge the cells into one
- Lines 237-241: Insert MFG value from Report 1 (C12) into G12 of new sheet, change the font size to 14, and create a border around the new cell
- Lines 244-247: Create range for the Barcode, merge into one cell, and create a border around the new cell
- Lines 250: Ask the user if there is a picture available for the item (Yes/No)
- Lines 253-297: If user selects "Yes", the user is taken to the File Explorer to choose the file from the designated area for photo and is placed in the top right corner of the placard in the designated area
- Likes 299-307: If the user selects "No" for the image, "Picture not available" is shown in the designated picture cells, aligned in the center horizontally and vertically

9.4 AISLE SIGN TEMPLATE

Aisle Signs should follow the following template guidelines as seen in **Figure 8**:

- Font: Bold, Calibri (Body)
- Row Font Size: 225
- Material Handler Font Size: 60
- Name Font Size: 150

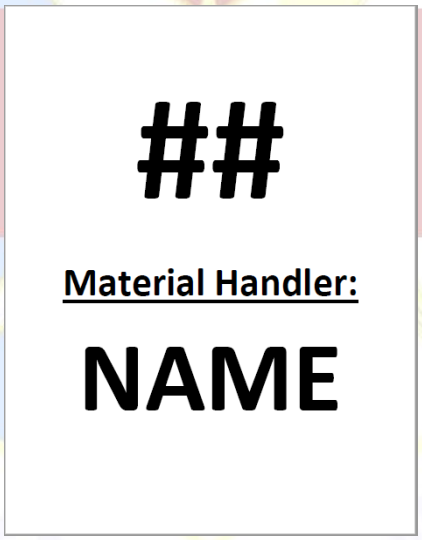


Figure 8: Aisle Sign Template